

CLAIMS

What is claimed is:

1. A high temperature superconductor mini-filter comprising:
- (a) a substrate having a front side and a back side;
 - (b) at least two self-resonant spiral resonators in intimate contact with the front side of the substrate, each of said resonators independently comprising a high temperature superconductor line oriented in a spiral fashion (i) such that adjacent lines are spaced from each other by a gap distance which is less than the line width; and (ii) so as to form a central opening within the spiral, the dimensions of which are approximately equal to the gap distance;
 - (c) at least one inter-resonator coupling;
 - (d) an input coupling circuit comprising a transmission line with a first end connected to an input connector of the filter and a second end coupled to a first one of the at least two self-resonant spiral resonators;
 - (e) an output coupling circuit comprising a transmission line with a first end connected to an output connector of the filter and a second end coupled to a last one of the at least two self-resonant spiral resonators;
 - (f) a blank high temperature superconductor film disposed on the back side of the substrate as a ground plane;
 - (g) a film disposed on the blank high temperature superconductor film as the contact to a case for said mini-filter;

- 5 (h) a superstrate having a front side and a back side, wherein the front side of the superstrate is positioned in intimate contact with the at least two resonators disposed on the front side of the substrate;
- 10 (i) a second blank high temperature superconductor film disposed at the back side of the superstrate as a ground plane; and
- (j) a second film disposed on the surface of said second high temperature superconductor film as a contact to a case for said mini-filter.

15 2. The mini-filter of Claim 1 wherein the superstrate is smaller in size than the substrate; and wherein the first end of the input coupling circuit and the first end of the output coupling circuit are each located outside the dimensions of the superstrate.

20 3. A high temperature superconductor mini-multiplexer comprising:

- 25 (a) at least two mini-filters, each mini-filter having a frequency band which is different from and does not overlap with the frequency bands of each other mini-filter;
- (b) a distribution network with one common port as an input for the mini-multiplexer and multiple distributing ports, wherein one distributing port is connected to a corresponding input of one mini-filter; and
- 30 (c) a multiple of output lines, wherein one output line is connected to a corresponding output of one mini-filter; wherein each of said at least two mini-filters comprises:
- 35 (d) a substrate having a front side and a back side;

- 5 (e) at least two self-resonant spiral resonators in intimate contact with the front side of the substrate, each of said resonators independently comprising a high temperature superconductor line oriented in a spiral fashion (i) such that adjacent lines are spaced from each other by a gap distance which is less than the line width; and (ii) so as to form a central opening within the spiral, the dimensions of which are approximately equal to the gap distance;
- 10 (f) at least one inter-resonator coupling;
- 15 (g) an input coupling circuit comprising a transmission line with a first end connected to an input connector of the filter and a second end coupled to a first one of the at least two self-resonant spiral resonators;
- 20 (h) an output coupling circuit comprising a transmission line with a first end connected to an output connector of the filter and a second end coupled to a last one of the at least two self-resonant spiral resonators;
- 25 (i) a blank high temperature superconductor film disposed on the back side of the substrate as a ground plane; and
- 30 (j) a film disposed on the blank high temperature superconductor film as the contact to a case for said mini-filter.

4. The mini-multiplexer of Claim 3 wherein each of said self-resonant spiral resonators has a shape selected from the group consisting of rectangular, rectangular with rounded corners, polygon and circular.

5. The mini-multiplexer of Claim 3 wherein a conductive tuning pad is disposed in the central

opening of one or more of said self-resonant spiral resonators.

6. The mini-multiplexer of Claim 3 wherein each self-resonant spiral resonator is selected from the group consisting of $\text{YBa}_2\text{Cu}_3\text{O}_7$, $\text{Tl}_2\text{Ba}_2\text{CaCu}_2\text{O}_8$, $\text{TlBa}_2\text{Ca}_2\text{Cu}_3\text{O}_9$, $(\text{TlPb})\text{Sr}_2\text{CaCu}_2\text{O}_7$ and $(\text{TlPb})\text{Sr}_2\text{Ca}_2\text{Cu}_3\text{O}_9$.

7. The mini-multiplexer of Claim 3 wherein each high temperature superconductor film is selected from the group consisting of $\text{YBa}_2\text{Cu}_3\text{O}_7$, $\text{Tl}_2\text{Ba}_2\text{CaCu}_2\text{O}_8$, $\text{TlBa}_2\text{Ca}_2\text{Cu}_3\text{O}_9$, $(\text{TlPb})\text{Sr}_2\text{CaCu}_2\text{O}_7$ and $(\text{TlPb})\text{Sr}_2\text{Ca}_2\text{Cu}_3\text{O}_9$.

8. The mini-multiplexer of Claim 3 wherein each substrate is selected from the group consisting of LaAlO_3 , MgO , LiNbO_3 , sapphire and quartz.

9. The mini-multiplexer of Claim 3 wherein one or more of said mini-filters contains an odd number of self-resonant spiral resonators with one resonator being centrally located and wherein the centrally located resonator comprises a double spiral form resonator comprising two connected spiral lines with a 180-degree rotational symmetry.

10. The mini-multiplexer of Claim 3 wherein all self-resonant spiral resonators have an identical configuration selected from the group consisting of rectangles, rectangles with rounded corners, polygons and circles.

11. The mini-multiplexer of Claim 3 wherein the input and output coupling circuits are in the parallel lines form and each comprises:

- (a) a microstrip line,
- (b) a gap between the said microstrip line and the first resonator for the input coupling circuit, or the last resonator for the output coupling circuit, of the said mini-filter, and
- (c) a gold pad at the end the microstrip line.

12. The mini-multiplexer of Claim 3 wherein one or more of said mini-filters further comprises:

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(k) a superstrate having a front side and a back side, wherein the front side of the superstrate is positioned in intimate contact with the at least two resonators disposed on the front side of the substrate;

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(l) a second blank high temperature superconductor film disposed at the back side of the superstrate as a ground plane; and

(m) a second film disposed on the surface of said second high temperature superconductor film as a contact to said case for said mini-filter.

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13. The mini-multiplexer of Claim 12 wherein the superstrate is smaller in size than the substrate; and wherein the first end of the input coupling circuit and the first end of the output coupling circuit are each located outside the dimensions of the superstrate.

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14. The mini-multiplexer of Claim 12 wherein each high temperature superconductor film is selected from the group consisting of $\text{YBa}_2\text{Cu}_3\text{O}_7$, $\text{Tl}_2\text{Ba}_2\text{CaCu}_2\text{O}_8$, $\text{TlBa}_2\text{Ca}_2\text{Cu}_3\text{O}_9$, $(\text{TlPb})\text{Sr}_2\text{CaCu}_2\text{O}_7$ and $(\text{TlPb})\text{Sr}_2\text{Ca}_2\text{Cu}_3\text{O}_9$.

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15. The mini-multiplexer of Claim 12 wherein each substrate and superstrate are selected from the group consisting of LaAlO_3 , MgO , LiNbO_3 , sapphire and quartz.

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16. The mini-multiplexer of Claim 12 wherein a conductive tuning pad is disposed in the central opening of one or more of said self-resonant spiral resonators.

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17. The mini-multiplexer of Claim 12 wherein each self-resonant spiral resonator is selected from the group consisting of $\text{YBa}_2\text{Cu}_3\text{O}_7$, $\text{Tl}_2\text{Ba}_2\text{CaCu}_2\text{O}_8$, $\text{TlBa}_2\text{Ca}_2\text{Cu}_3\text{O}_9$, $(\text{TlPb})\text{Sr}_2\text{CaCu}_2\text{O}_7$ and $(\text{TlPb})\text{Sr}_2\text{Ca}_2\text{Cu}_3\text{O}_9$.